

## ***Bolbosoma turbinella* (Acanthocephala) in a Blue Whale, *Balaenoptera musculus*, Stranded in the St. Lawrence Estuary, Quebec**

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**ABSTRACT:** A stranded blue whale, *Balaenoptera musculus* (L.), on the north shore of the St. Lawrence River, Quebec, Canada, was examined for parasites. The acanthocephalan *Bolbosoma turbinella* (Diesing, 1851), found in all sections of the small intestine examined, was the only parasite observed. This is a new geographic and host record. The proboscis of adult *B. turbinella* has 18 to 21 longitudinal rows of hooks in males and 20–21 in females, with 6 to 7 hooks per row. Lemnisci were 9–18 mm long in males and 6–22 mm long in females.

**KEY WORDS:** *Bolbosoma turbinella*, Acanthocephala, blue whale, *Balaenoptera musculus*, St. Lawrence River, Canada.

The epizootiology of parasites of cetaceans is poorly understood. Early parasitological studies consisted of reports of parasites in whales, mostly mysticetes, taken during commercial whaling, particularly in Antarctica and the North Pacific Ocean. Parasite–host lists have been published by Margolis (1954), Delyamure (1955), Dailey and Brownell (1972), and Margolis and Dailey (1972). Dailey and Vogelbein (1991) examined the helminth fauna of 3 Antarctic whale species to determine its use as stock indicators.

Cowan (1967) examined helminths of pilot whales (*Globicephala melaena*) collected off Newfoundland. Over the past 30 yr at least 24 putative blue whales have stranded on the east coast of Canada (Béland et al., 1987; M. Kingsley, Dept. Fish. and Oceans, unpubl. data), but no parasitological data from these strandings have been published.

### **Materials and Methods**

We examined a blue whale, *Balaenoptera musculus* (Linnaeus, 1758), which had stranded on 11 October 1990 on the north shore of the St. Lawrence River, 7 km west of Franquelin, Quebec, Canada (49°17'N, 67°54'W).

The whale was dissected on 12–13 October. The following organs were examined for parasites: liver, heart, left lung, proximal end of the esophagus, fore-stomach, main stomach, pyloric stomach, a randomly chosen 3-m section and 4 additional 1-m sections of the small intestine, and the colon. Parasites removed were placed in mammalian saline and later transferred to 70% ethanol.

Acanthocephalans were transferred to glycerin alcohol (9 parts 70% alcohol : 1 part glycerin) and cleared by evaporation. Some specimens were cleared in lactic acid or dissected. Others were prepared for scanning

electron microscopy (SEM) by dehydration through a series of increasing concentrations of ethyl alcohol, postfixed in 1% osmium tetroxide, dried by critical point drying using carbon dioxide substitution, and coated with gold palladium. Acanthocephalans were studied using a JEOL JSM-T330 scanning electron microscope at 20 kV. Measurement and morphological study of acanthocephalans were made using a Leitz Diaplan microscope equipped with a drawing tube coupled with a digitizer tablet and computer. Measurements are in micrometers unless otherwise indicated.

### **Results**

The whale was 19.65 m long from the tip of the snout to the notch between the tail flukes (measured in a straight line). Weight was estimated at 46.3 tonnes using the formula  $W = aL^b$ , given by Lockyer (1976). The whale was a young female estimated by length to be less than 2 yr old (Rudd et al., 1950). Time of death was estimated to have been no more than a few days previous. Most tissues were in good condition; however, decomposition was beginning (the epithelium of the skin was beginning to form blisters and slough off and there was some gas escaping from the body cavity as it was opened). No food was found in the portions of the gastrointestinal tract examined.

The only parasite found was *Bolbosoma turbinella* (Diesing, 1851) Porta, 1908, which was present in the small intestine. No definitive count of *B. turbinella* was made; however, hundreds were observed. As worms were removed, only a cylindrical cavity in the mucosa where the proboscis had been embedded was observed. A sample of 55 was collected for identification. Voucher specimens of *B. turbinella* (CMNP1991-0014)

**Table 1.** Values of mensural and meristic characters of *Bolbosoma turbinella* from the small intestine of *Balaenoptera musculus* (L.) from the St. Lawrence Estuary, Quebec, Canada.\*

Character	Males (N = 10)	Females (N = 10)
Total length (mm)	19.3 ± 3.2 (15.2–24.9)	19.9 ± 2.7 (17.2–26.2)
Bulb width (mm)	2.3 ± 0.2 (2.1–2.7)	2.5 ± 0.3 (2.1–2.7)
Bulb length (mm)	1.0 ± 0.2 (0.8–1.3)	1.2 ± 0.1 (1.1–1.4)
Neck length	310 ± 95 (207–475)	325 ± 82 (212–399)
Neck width (maximum)	637 ± 64 (494–735)	725 ± 84 (628–903)
Proboscis length	758 ± 64 (648–833)	799 ± 66 (653–900)
Proboscis width (at basal row of hooks)	625 ± 65 (530–739)	680 ± 72 (580–766)
Proboscis receptacle length (mm)	1.5 ± 0.2 (1.2–1.9)	1.5 ± 0.1 (1.3–1.7)
Proboscis receptacle width (maximum)	629 ± 45 (559–689)	623 ± 97 (491–816)
No. longitudinal rows of hooks on proboscis	19 ± 1 (18–21)	20 ± 0.4 (20–21)
No. hooks per row on proboscis	(6–7)	(6–7)
Lemnisci length (mm)	13.3 ± 2.4 (9.3–18.4)	14.5 ± 4.0 (6.3–22.3)
Anterior testis†	14.0 ± 2.6 (10.0–18.1)	—
Diameter of anterior testis	796 ± 288 (471–1,434) × 732 ± 266 (357–1,211)	—
Posterior testis†	13.0 ± 2.3 (9.0–16.9)	—
Diameter of posterior testis	800 ± 301 (435–1,450) × 779 ± 268 (428–1,197)	—
Diameter of eggs‡	—	(41–61) × (14–22)

\* Measurements (in micrometers unless otherwise noted) are mean ± standard deviation with range in parentheses.

† Distance from posterior extremity to anterior margin of testis.

‡ Eggs were not mature and were taken from the uterus and pseudocoel of 4 females. Other females had no eggs.

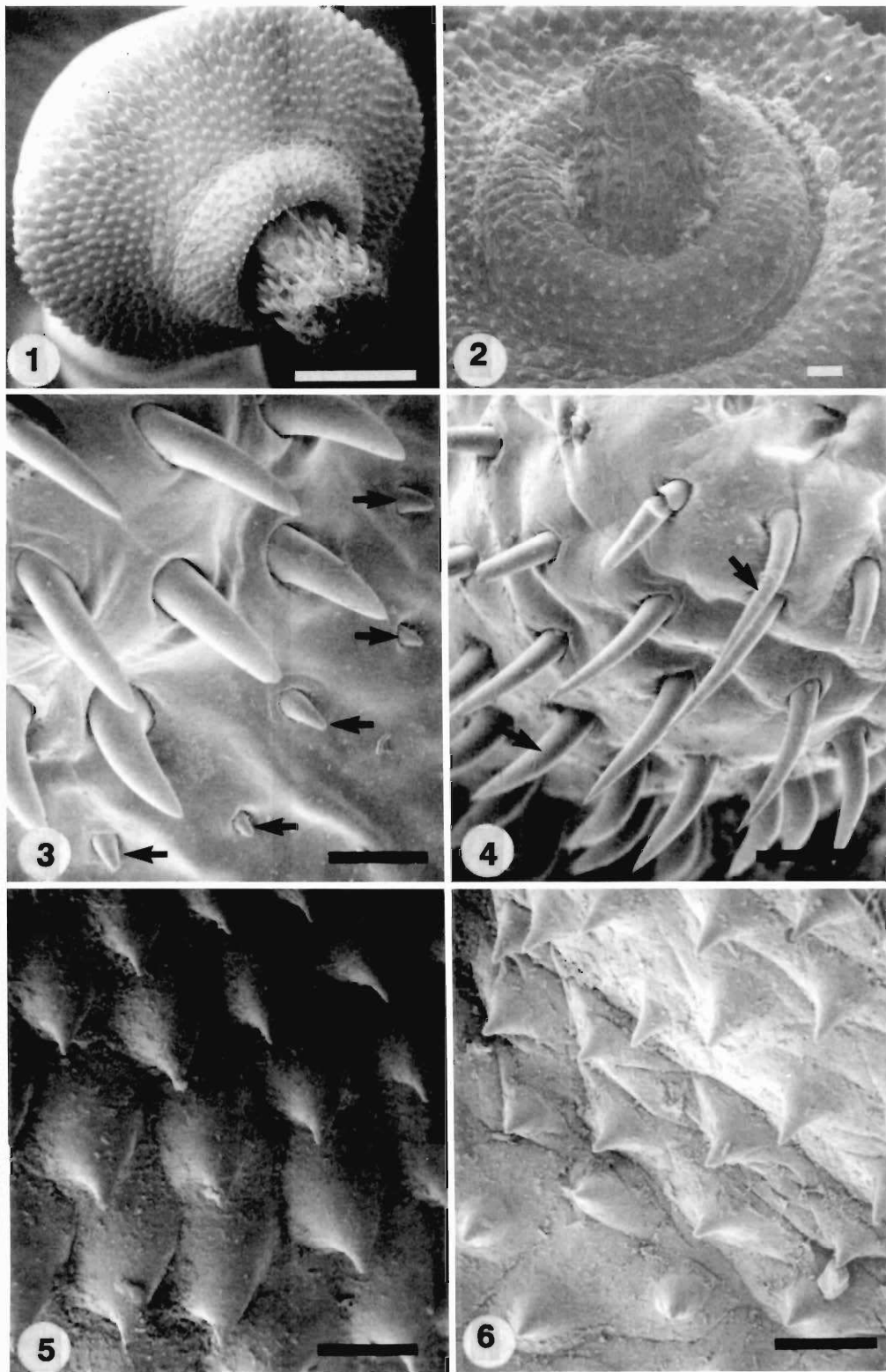
were deposited in the Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, Ontario, Canada K1P 6P4.

Female *Bolbosoma turbinella* had immature eggs. Each egg contained an immature embryo but eggs lacked polar elongations. The proboscis was conical; males had 18–21 longitudinal rows of hooks and females had 20–21 (Table 1; Figs. 1, 7). There were 6–7 hooks per row on the proboscis of male and female specimens (Fig. 2). Apical hooks ( $N = 8$ ) on the proboscis were slender (52–90 long in males and 88–114 long in females [Fig. 4]) with slender oblong roots (69–85 long in males and 80–98 long in females). Median hooks ( $N = 20$ ) were robust (81–107 long in males and 82–127 long in females [Fig. 4]) with wide oblong roots (70–119 long in males and 96–125 long in females). Basal hooks ( $N = 20$ ) were reduced (6–28 long in males and 10–90 long in females [Fig. 3]) with wide ovate roots (10–41 long in males and 10–93 long in females). The bulb (Fig. 1) had flat, scalelike spines located close to the outer perimeter of the bulb (Fig. 5) and erect spines located close to the base of the proboscis (Fig. 6). Spines ( $N = 10$ ), were 17–119 long in males and 34–118 long in females. Spines were not observed elsewhere on the body. Lemnisci were long, often convoluted, and frequently terminated just posterior to the posterior testis.

In a few specimens, lemnisci extended close to the posterior extremity of the body. Values of mensural and meristic characters are given in Table 1.

### Discussion

This is the first report of *Bolbosoma turbinella* in blue whales from North American waters and the first from the eastern coast of North America. As the identification of *Bolbosoma* spp. is problematic, it may be useful to mention species of *Bolbosoma* reported in whales from North American waters. These include: *B. turbinella* in the sei whale (*Balaenoptera borealis*) from the Pacific Ocean off British Columbia (Margolis and Pike, 1955); *Bolbosoma capitatum* (Linstow, 1880) Porta, 1908, in pilot whales (*Globicephala melaena*) collected off Newfoundland (Cowan, 1967); *Bolbosoma* sp. from an Atlantic white-sided dolphin (*Lagenorhynchus acutus*) stranded in Maine (Beverley-Burton, 1978); *Bolbosoma vasculorum* (Rudolphi, 1819) Porta, 1908, from a pigmy sperm whale (*Kogia breviceps*) stranded in Georgia (Pendergraph, 1971); *Bolbosoma balaenae* (Gmelin, 1790) Porta, 1908, from an unidentified whale examined at Seattle, Washington (Van Cleave, 1953); *Bolbosoma* sp. in the gray whale (*Eschrichtius robustus*) from the Pacific Ocean off California (Rice and Wolman,

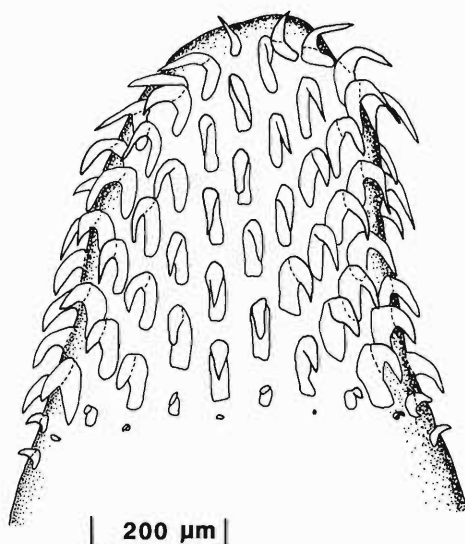


1971); and *Bolbosoma* sp. in the sei whale, blue whale, and humpback whale (*Megaptera novaeangliae*) off California (Rice, 1963). Rice (1978) reported *B. nipponicum* Yamaguti, 1939, in blue whales collected and examined off California.

Amin (1985) lists 14 nominal species of *Bolbosoma*. Characters usually used to distinguish species are the number of longitudinal rows of hooks and the number of hooks per longitudinal row of hooks on the proboscis all of which, however, show considerable overlap. The number of longitudinal rows of hooks and the number of hooks per longitudinal row (in parentheses) on the proboscis of *B. turbinella* have been reported as 14–16 (7) (Porta, 1908), 20–22 (6–8) (Harada, 1931), 19–20 (6–7) (Meyer, 1933), 20–22 (7–8) (Margolis and Pike, 1955) and 6–7 hooks (?) (Diesing, 1851).

*Bolbosoma turbinella* is not restricted to blue whales. It also has been reported previously from several mysticetes (blue whale, sei whale, fin whale, humpback whale, and North Atlantic right whale [*Eubalaena glacialis*]) and 1 odontocete (the North Atlantic bottlenose whale [*Hyperodon ampullatus*]), which is the type host according to Diesing (1851). Distribution of *B. turbinella* in whales includes the Atlantic and Pacific oceans in the northern and southern hemispheres.

Blue whales are stenophagous, i.e., they have a narrow range of food consumed. The diet of blue whales in the Gulf of St. Lawrence is unknown. However, Klumov (1963) lists food items in the stomach of blue whales examined elsewhere in the North Atlantic Ocean, including the euphausiids *Thysanoessa inermis*, *T. longicauda* and *Meganctiphanes norvegica*. In the lower estuary of the St. Lawrence, *T. inermis*, *M. norvegica*, and *T. raschi* occur in dense swarms of up to 700 km<sup>2</sup> at depths of 50–175 m during summer (Berkes, 1976; Simard et al., 1986; Runge and Simard, 1990). As blue whales usually feed below 50 m deep (Klumov, 1963), they are likely ingesting these euphausiid species. Shimazu (1975)



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Figure 7. Proboscis of *Bolbosoma turbinella*, adult male. Note slender apical hooks, robust median hooks, and reduced basal hooks.

reported juvenile *Bolbosoma caeniforme* (Heitz, 1919) Meyer, 1935, from *T. longipes*, *T. raschi*, and unidentified species of euphausiids collected in the North Pacific Ocean. Female *B. turbinella* found in the present study contained immature eggs suggesting that blue whales are infected in the lower estuary of the St. Lawrence River or Gulf of St. Lawrence where they feed 9 mo of the year (Sears et al., 1990).

Two of the 4 other mysticetes reported infected with *Bolbosoma turbinella* are copepod specialists (sei whale, right whale), but they also feed on euphausiids (Mitchell, 1975). The fin whale and the humpback whale are generalists and euryphagous, feeding on swarming fish such as capelin, herring, cod, sardine, and mackerel (Nemoto, 1959; Klumov, 1963; Mitchell, 1975). Thus the latter 2 species of whales likely acquire *B. turbinella* from infected fish that probably serve

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Figures 1–6. Scanning electron micrographs of *Bolbosoma turbinella* from a blue whale, *Balaenoptera musculus* (L.). 1. Anterior extremity of adult female showing bulbous expansion of anterior part of trunk (=bulb) and proboscis. Scale bar = 500  $\mu$ m. 2. Proboscis of adult female showing arrangement of longitudinal rows of hooks. Scale bar = 100  $\mu$ m. 3. Proboscis showing reduced hooks (arrows) in basal row. Scale bar = 50  $\mu$ m. 4. Subapical view of proboscis showing a slender apical hook (upper arrow) and a robust medial hook (lower arrow). Scale bar = 50  $\mu$ m. 5. Flat scalelike spines on bulb located close to outer perimeter of bulb. Scale bar = 50  $\mu$ m. 6. Erect spines on bulb, located close to base of proboscis. Scale bar = 50  $\mu$ m.

as paratenic hosts. Reports of juvenile *Bolbosoma* sp. in fish involve members of Scombridae, Scorpaenidae, Carangidae, Trichiuridae, Gempylidae, Salmonidae, Berycidae, Lophotidae, Gadidae, and Belonidae (Harada, 1935; Kamegai, 1962a, b; Kato et al., 1963a, b; Mamaev and Baeva, 1963; Zhukov, 1963; Ichihara, 1964a-c; Mamaev, 1965; Sey, 1970; Bussieras and Baudin-Laurencin, 1973; Pennell et al., 1973; Butorina, 1976; Wang, 1980; Rego and Santos, 1983; Arthur, 1984; Arai, 1989). Most of these reports are from the North Pacific Ocean where *B. turbinella* is known to occur. However, Bakey and Zubchenko (1984) found *B. vasculorum* in the roundnose grenadier, *Coryphaenoides rupestris* (Macrouridae), collected in the North Atlantic Ocean.

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